

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTONNOTES ON THE PLANT GENUS *PANDANUS* IN
FIJI, TONGA, THE NEW HEBRIDES, AND NIUE¹

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No critical treatment of Fijian *Pandanus* has appeared since Martelli's (1930A). At the same time Martelli (1930B) also discussed *Pandanus* in Tonga. A. C. Smith (1936) discussed two *Pandanus* species, one of them proposed as new. Since 1936 a number of collections, primarily made by A. C. Smith, have become available. These extend the known distributions of certain species and also indicate the need for a review of the taxonomic status of various taxa in the flora of this region of the Pacific.

The Fijian species of *Pandanus* may be arranged in four of the sections of the genus; *Acrostigma*, *Coronata*, *Maysops*, and *Pandanus*. Two other sections, *Hombrobia* and *Microstigma*, are represented by a single species each from the New Hebrides. In Fiji there are several well-defined species, one in Sect. *Acrostigma*, one in *Maysops*, and two in *Coronata*. The species of Sect. *Pandanus* are more difficult to interpret because of the several difficulties, both taxonomic and nomenclatural in nature, which have yet to be solved, and which involve not only the plants of the area here considered but those of the entire Pacific and indeed those of Malaysia and the Indian Ocean. Therefore, consideration of the members of Sect. *Pandanus* is postponed, except for one newly proposed variety. Traditionally, these species which are largely littoral in habitat and dispersed by oceanic currents, have been brought together under a single name; usually either *P. odoratissimus* or *P. tectorius*. Serious drawbacks have stood in the way of using either of these names; in the first case, the name *P. odoratissimus* has been claimed to be illegitimate (see for instance DeWit, 1959). In any event, it is a native of Ceylon and adjacent Malaysia, extending to the Philippines, and may be recognized by its relatively small phalanges, and, in particular, by its very stoutly toothed leaves. I do not believe

¹Based on studies made at the U.S. National Herbarium through the courtesy of Dr. A. C. Smith.

that this species occurs beyond the limits of Malaysia as defined in the "Flora Malesiana."

With the name *P. tectorius* we have a different problem. The epithet is doubtless to be rejected under the terms of the International Code, since its usage has led to consistent and constant confusion. If, however, steps were taken to reintroduce the name, accompanied by a neotype collection from the type locality (in Tahiti) with mature fruits in abundance, the name could be taken up, and would no doubt be applicable to a widespread but perhaps typically Polynesian species. There are at present quite probably far too many specific "entities" for the Polynesian species of *Pandanus*. Martelli (1933A and 1933B) does not broach this problem; yet he accepts eight species of Sect. *Pandanus* in Tahiti, and three in Rarotonga (one of which is said to occur also in Tahiti). The oldest name he accepts is *P. Menziesii* Gaudich., which, however, is applied to a Hawaiian plant. Brown (1931) accepts *P. tectorius*, and describes a number of taxa as new; nowhere, however, is the name *tectorius* clearly defined or typified. Other writers on Polynesian botany generally use the name *P. tectorius*. Martelli (1934) in his treatment of Samoan Pandanaceae recognizes only two varieties of *P. odoratissimus*, one of them the var. *laevis*, which is cultivated and known only in the sterile state; the other is var. *savaiensis* (Martelli) Martelli, first described as a variety of *P. tectorius*.

The cardinal point is, of course, the matter of specific delimitation. So long as but one species is accepted for the region from the Indian Ocean to the Eastern Pacific, as far north as the Bonin and Hawaiian Islands and south to the Austral Islands and Australia, there is, perhaps, no real objection to using one of these names. But once a more intensive study is made of the plants from this vast area, it becomes abundantly clear that the situation is not nearly so simple. While of course it is true that littoral species are often rather uniform over a large area, it is also obvious that the forces of evolution as expressed in insular environments have not suspended operations. But other considerations complicate the situation immensely. *Pandanus* must be considered as a crop plant in many areas, and it is clear that deliberate man-made introductions of *Pandanus* plants occur, not only in Polynesia, but in Micronesia and in Melanesia, and no doubt across the natural range of the genus. In certain areas the production of numerous cultivars for food or for foliage has been accomplished by a long process of selection; in some cases the number of clones produced (and in general they are always vegetatively propagated) is extraordinarily large, mainly in the Gilbert and Marshall groups.

Merrill (1954) has discussed the nomenclatural problems posed by Parkinson's (1773) book. It is not necessary here to repeat his remarks, but in his general consideration, he calls for an official rejection of the book as a whole. Many, if not most, of the names published in Parkinson's book are *nomina subnuda*; but with *P. tectorius* there is a discus-

sion of eleven lines of print. Unfortunately, other than immediately identifying the genus, there is no way of knowing what species Parkinson meant. St. John (1963) has rejected the name because it is a hyphenated binomial, which he deems a monomial.

Probably a solution by international fiat through the appropriate committees is necessary; and if the general rejection is not approved, only a new typification, as earlier mentioned, can elucidate the situation.

In the meantime one can only use those names which are well-founded, which merely postpones the nomenclatural problems, but at least may further taxonomic knowledge. I have with great hesitation attempted such a temporal compromise in this treatment, knowing full well that future studies will bring about a number of changes. Progress in understanding of the intricately variable Pacific species is bound to depend at least at first on a rather narrow interpretation of taxa, and more important perhaps, much more serious field studies and collecting; and it might be remarked that illustrations are mandatory.

KEY TO THE SECTIONS OF *PANDANUS* IN FIJI, TONGA, NEW HEBRIDES,
AND NIUE

Drupes all or nearly all one-celled

Stigmas spiniform, longer than broad, subulate or curved-acicular,
erect or mostly ascending, stigmatic groove dorsal *Acrostigma*

Stigmas suborbicula or reniform, broader than long, flattened

Stigmas lateral, erect or ventral, commonly attached at or near
the edge of the drupe *Maysops*

Stigmas apical or subapical, plane or slightly oblique *Microstigma*

Drupes all or nearly all several-celled

Stigmas radiate or concentric in arrangement

Stigmas lateral and subvertical, arranged around the truncated
apex of the phalange, centrifugal *Coronata*

Stigmas mostly subplane, each borne on a more or less distinct
carpel apex, concentric, centripetal *Pandanus*

Stigmas in one or more transverse lines (if several, then parallel)
..... *Hombronia*

Sect. *Acrostigma* Kurz

1. *Pandanus thurstonii* Wright in Kew Bull. 1894: 348. 1894; Martelli in Univ. Calif. Publ. Bot. 12: 335. 1930; Smith in Bishop Mus. Bull. 141: 12. f. 4-a, e. 1936.

P. caricosus sensu Seem. Fl. Vit. 281. 1866 (non [Rumph.] Sprengel, 1826), *fide* Martelli.

P. virens Horne, A Year in Fiji, 264. 1881. *nom. nud.*

Type locality: Viti Levu: Near Suva (*Thurston*, K.).

Reported from Koro, in a swamp at 500 m alt. (Smith 992, BISH, US) by Smith. The species does not reappear in recent collections. The natives of Koro know the plant as *varawa*, and use it in weaving mats. It is endemic.

Sect. *Maysops* St. John

2. *Pandanus joskei* Balf. f. in Journ. Linn. Soc. Bot. 20: 416. 1884; Martelli in *Webbia* 4 (1): 18. 1913; et 4 (2): t. 24. f. 1-3 1914; in Univ. Calif. Publ. Bot. 12: 334. 1930.

Type locality: "Fiji Isl.". Holotype: *Jeoward*, K. The original description was based on notes and sketches made by Horne.

Reported from Viti Levu ("common between the Wai Manu and the Rewa River on alluvial land; also on damp spots near streams in mountains at sources of Tamarina River, between Suva and the Rewa River" (*Jeoward*); Mt. Korombamba (*Parks* 20344, BISH, UC, US).

A thoroughly distinct and handsome species. It does not appear again in more recent collections at hand.

Fiji: Viti Levu: Mba; vicinity of Nandarivatu, *Gillespie* 3734, BISH.

Sect. *Microstigma* Kurz

3. *Pandanus cominsii* Hemsl. in Hook. f. Icon. 27: t. 2654. 1900; Martelli in Bot. Jahrb. 49: 66. 1912; in *Webbia* 4: t. 26. f. 20. 1914; in Journ. Arnold Arb. 12: 269. 1931.

Type locality: Solomon Islands; Florida Is. Holotype: *Comins* 363, K.

Reported only from the Banks Group, Vanua Lava Island, just north of the New Hebrides (*Kajewski* 471), by Martelli. The species is common in the Solomon Islands; a peculiar variety occurs in Micronesia on the islands of Truk and Ponape.

In Efaté, New Hebrides, I observed what in all probability was this species but was unable to make a collection, on a trip from Port Vila to Onesua in 1957.

Section *Coronata* Martelli

Key to Species

- Stigmas mostly 4-6 per phalange; phalanges² compressed obovate-oblancoolate *P. whitmeeanus* Martelli
 Stigmas mostly 10-16 (or more) per phalange; phalanges, rhomboid, pentahexagonal, but slightly or not compressed *P. citiensis* Martelli
4. *Pandanus whitmeeanus* Martelli in *Webbia* 1: 364. 1905; 4 (1): 36. 1913; 4 (2): t. 22. f. 4-6. 1914; Setchell, Veg. Tutila Isl., Carnegie Inst. Publ. 341: 117. 1924; Martelli in Univ. Calif. Publ. Bot. 12: 259. pl. 45. f. 8-9. 1930; in Bishop Mus. Occ. Pap. 10 (13): 23. 1934; St. John in Pac. Sci. 14: 228. 1960.

Type locality: Samoa. Holotype: *Whitmee* s.n., K.

² The multilocular segment of the cephalium; also termed a polydrupe.

Branching trees to 10 m tall or more; leaves 180–275 cm long, or up to 500 cm long, 8–10 cm broad toward the base, at apex gradually long-acuminate, not or very briefly (3–4 cm) flagellate; margins serrate-dentate, at base the teeth stout, antrorse, hooked, 2–3 mm long; toward middle and at apex teeth reduced, minute, 1.0 mm long or less, crowded (about 6–7 per cm), slightly larger teeth alternating with slightly smaller ones; costa dorsally unarmed at base, dentate along the apical third with teeth subsimilar to those of adjacent margins but slightly more distant; ventral pleats apically set with small antrorse teeth like those of margins; sheathing base indurate, rigid, thick. Syncarps subglobose, obscurely trigonal, erect, c. 22–23 cm long, c. 23 cm in diameter, borne on a trigonal peduncle up to 30 cm long; phalanges 250–350 per syncarp, about 7–8.5 cm long and 3 cm broad when mature, compressed (c. 1.8–2 cm thick), with 3–6, usually 4–6 locules; phalange a unit, the carpels completely connate, narrowly obovate in profile, the apex flat to slightly concave, 5–6-angled; sides smooth; upper $\frac{1}{4}$ green, lower $\frac{3}{4}$ yellow to yellow-orange at maturity; bases of mutually adjacent phalanges not connate. Stigmas 3–6, external, on the distal face of the phalange, surrounding the apical areola, nearly vertical, narrowly elliptic or linear, grooved at the base, about 4×2 mm, set usually at or near the angles of the phalange; endocarp submedian, with 3–6 seeds usually in two rows, each c. 18×5 mm; upper mesocarp fibrous, pithy, solid (not cavernose); lower mesocarp fibrous, the fibers traversing a fleshy pulp. (Fig. 1)

Distribution: Fiji, Samoa, and Tonga: (Cultivated and visited for the leaves, which are of textile quality); New Hebrides.

Local names: “paongo” in Tonga and Samoa; “ndaundreka” in Fiji; “na parou” in Nguna, New Hebrides.

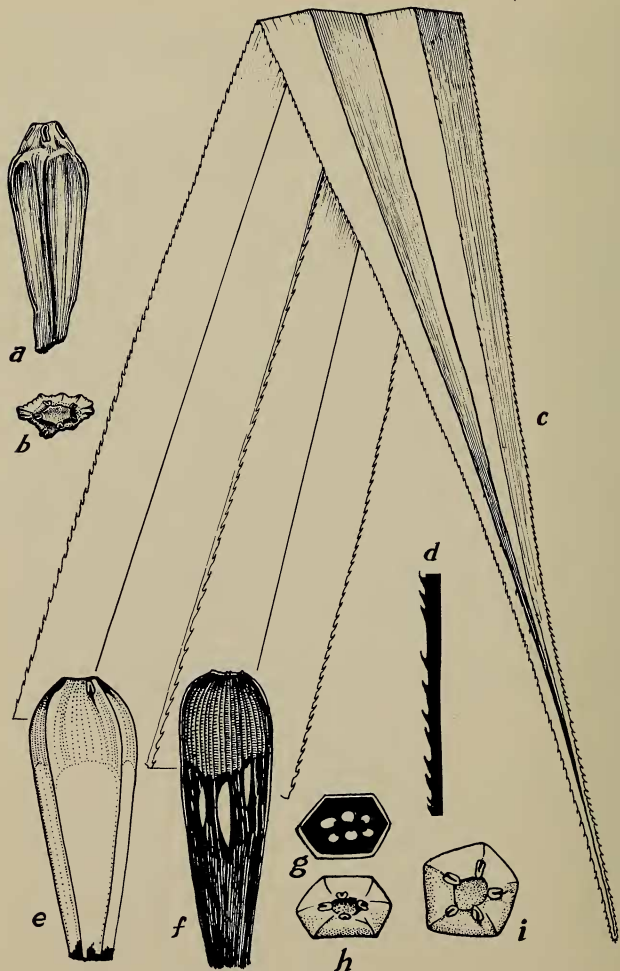
Known in Samoa from Savaii (Safotu, cultivated, *Christophersen & Stehlin* 3597) and from Tutuila (Pango Pango, *Setchell* 300, and Pioa, *Christophersen* 3580); in Tonga from Tongatabu (*Setchell & Parks* 15650).

New Hebrides: Nguna Is. (just north of Efaté), Mt. Mawasi, c. 330 m alt., Sept. 1957, *Stone* 2208, 2210, BISH.

Fiji: Viti Levu: Serua; Flat coastal strip in vicinity of Ngaloa, alt. nr. sea-level, (freely branched tree to 15 m high, in swampy grass-flats and on edge of forest; leaves to 5 m long, locally considered the best for mats, for which young plants are used), *Smith* 9436, US.

The Fijian material cited is the best collection of this species from Fiji. It is a good match for the species, although the fruits are quite immature; a phalange and leaf apex are illustrated. Mature phalanges of *Stone* 2208 from Nguna, New Hebrides, are illustrated.

The discovery of this characteristic species in Fiji and in the New Hebrides is in accord with the pattern of distribution for this region as manifested in various other species. The New Hebridean material is also the first known from that area.



Species dubius aff. *P. whitmeeanus*

Pandanus corallinus Martelli in Univ. Calif. Publ. Bot. 12: 359. pl. 45.
Figs. 10-12. 1930. Yuncker in Bishop Mus. Bull. 220: 50. 1959.

Type locality: Tonga; *Tongatabu*. Holotype: *Setchell & Parks* 15420, UC.

There seems to be no doubt that the phalanges representing this species display the stigmatic structure and arrangement typical of this section. However, there is considerable doubt about the validity of the species, since the phalanges obtained are all from the peduncular region of the syncarp (as evidence by their falcate shape). They are perhaps immature; at best they are distortions of the more lateral or apical phalanges. The color, "coral red," does not correspond either with *P. vitiensis* or with *P. whitmeeanus*; but I regard it as probable that *P. corallinus* will prove to be a synonym of *P. whitmeeanus*. The collection consisted of phalanges which had been made into a necklace or lei and were worn by a Tongan woman at Mua. There is some doubt as to whether they were gathered in Tongatabu or in 'Eua.

5. *Pandanus vitiensis* Martelli in Univ. of Calif. Publ. Bot. 12: 333. pl. 42. 1930; Perry in Journ. Arnold Arb. 31: 208 in obs. 1950.

P. levuensis Martelli in Univ. Calif. Publ. Bot. 12: 334. pls. 43-44. 1930.

Type locality: Fiji: Viti-Levu; Tholo-i-Suva, 300 m. Holotype: *Parks* 20980, UC.

The first syntype cited of *P. levuensis* (here chosen lectotype) is *Parks* 20345, from Mr. Korombamba, Viti Levu; it is merely a very immature specimen of *P. vitiensis*, which accounts for the smaller phalanges as described by Martelli. The other syntype cited (*Gillespie* 3443.I) from Nasinu, Viti Levu, is also quite immature. It may represent *P. whitmeeanus*.

Distribution: Fiji, endemic. A small tree or up to 15 m high.

The most recent collection is that mentioned by Perry, which is cited again here.

Fiji: Viti Levu: Mba: Southern slopes of Mt. Ndelainathovu, on

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FIG. 1. *Pandanus whitmeeanus* Martelli. (a-d, *Smith* 9436 from Fiji; e-i, *Stone* 2208, from New Hebrides). a. immature phalange in profile, $\times \frac{1}{2}$. b. the same in top view. c. leaf apex showing ventral (and at left) dorsal surfaces, $\times \frac{1}{2}$. d. teeth of leaf-margin in silhouette (from near leaf-base) $\times \frac{1}{2}$. e. phalange in profile, mature. f. the same in longi-section, $\times \frac{1}{2}$. g. cross-section of the same through the endocarp. h. top view of the same. i. top view of another phalange from the same collection.

the escarpment west of Nandarivatu, alt. 870–970 m, in dense forest (plant 4–10 m high, trunk straight, slender 15–20 cm diam., unbranched nearly to summit then with a few spreading branches; fruit terminal, surrounded by densely congested leaves; leaves used for weaving mats), 26 June 1947, *Smith* 4917 (A, BISH, BRL, K, US). Locality uncertain (probably near Nandarivatu), *Gillespie* 3734 (A, BISH).

Sect. *Hombronia* (Gaudich.) Warb.

Key to species in Fiji, Tonga, New Hebrides, and Niue

Phalanges mostly 7–15 cm long; coastal and lowland species.

Stigmas mostly 1–3, apical, more or less erect; phalange apex acute or convex; seed usually single, central *P. dubius* Spr.

Stigmas mostly 3–4, or up to 5–7, rarely only 1; phalange apex truncated or concave; seeds usually 2–3, basal *P. compressus* Martelli

Phalanges much smaller, not over 6 cm long;

Montane Samoan species *P. reineckeii* Warb.

6. *Pandanus dubius* Sprengel, Syst. III: 897. 1826; Kurz in Journ. Bot. 5: 127. t. 64, f. 1–2. 1867.

P. Hombronia (Gaud.) F.v. Mueller, Victorian Nat. p. 143. 1890.

Hombronia edulis Gaudichaud, Bot. Voy. Bonite, Atlas t. 22, f. 17. 1843.

Type locality: Amboina. Holotype: Rumphius, Herb. Amb. t. 80. 1743.

New Hebrides: Nguna Is. just north of Île Vaté; Taloa village, on the shore, 3 Sept. 1957, *Stone* 2207 (BISH; to be distributed); no definite locality, Oct. 1944, *R. Christoffersen* s.n. (A).

First records from the New Hebrides.

A common littoral species throughout Malaysia, Eastern Melanesia, and part of Micronesia. The vernacular name in Ngunese is “na vaku.” The thickish, large, bluntly acuminate glossy coriaceous leaves are water-repellent and favored for coarse matting used as rain guards. The species was observed but not collected on the slopes of Mt. Mawasi, at nearly 300 m elevation, where it had been planted in a settlement; and on Île Vaté, at Onesua, on the north-east coast. The large seeds are edible, with a flavor much like that of coconut meat.

Not known so far from Fiji, Samoa, or Tonga, nor from anywhere else in Polynesia.

7. *Pandanus compressus* Martelli, Webbia 1: 363. 1905; 4: t. 10, f. 14–15. 1913.

P. tetradon (Gaudich.) Balf. f. ex Kanehira, Bot. Mag. Tokyo, 52: 236–239. f. 70. 1938. Not *P. tetradon* Ridley, 1915.

Barrotia tetradon Gaudich., Bot. Voy. Bonite, Atlas, t. 13, f. 1–8. 1843.

Barrotia Gaudichaudii Ad. Brongniart, Ann. Sci. Nat. ser. 6, 1: 264. 1875. Nomen nudum.

Type locality: Solomon Islands. Holotype: *Guppy* s.n., FI.

This species, so very similar to *Pandanus dubius*, but with basal, more numerous seeds and more compressed and apically truncate or slightly concave phalanges, is represented clearly in some photographs sent to me recently by Jacques Barrau (then) of the South Pacific Commission. Close-ups of the fruits and habit of the tree are shown. The plants were growing in Tongariki, Shepherd Is., in the New Hebrides region, where they were called "navaka" (Barrau in lit. 20 August 1964). No specimens were taken; however, there can be no doubt of the identity of the plants. (Fig. 2)

8. *Pandanus reineckei* Warb. in Bot. Jahrb. 25: 581. 1898; in Pflanzenr. 3 (IV.9): 52: 1900; Martelli in Bishop Mus. Occ. Pap. 10 (13): 22. 1934.

Type locality: Tutuila Is., 500–600 m. Holotype: *Reinecke* 459, B.

A full description and citation of all specimens presently known are to be found in Martelli's treatment. The Samoan name for the species is "paongo."

Distribution: The species is endemic to Samoa; it has been collected on the summits of several ranges in Savaii, Upolu, and Tutuila.

Section *Pandanus*

The treatment of members of this section is postponed, awaiting a solution to the problem of the identity and typification of *Pandanus tectorius*, and only the description of one new variety of *Pandanus tahitensis* is included here.

9. *Pandanus tahitensis* Martelli in Webbia 2: 428. 1907; 4: 33. t. 7. Figs. 1–3. 1913; in Univ. Calif. Publ. Bot. 17: 152. *nomen*. 1933.

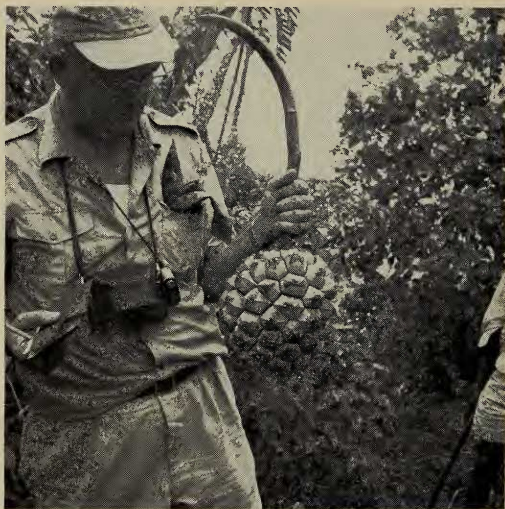
Type locality: Tahiti. Holotype: *MacFarlane* 2, FI.

Distribution: Formerly supposed to be a Tahitian endemic; but if I am correct in the identification, it is found in Tonga and Fiji at least in the form of separate varieties. Here, however, only an undescribed variety from Niue is discussed.

Pandanus tahitensis Martelli var. **niueana** B. C. Stone, var. nov.

Arbor ad 4 m alta; infructescentibus longe pedunculatis, pedunculis c. 30 cm longis; syncarpio c. 30 × 30 cm; phalangibus late obovoideis, apice hemisphericalibus, loculorum apicibus subplanatis convexis non liberis stigmatibus terminalibus depressis hippocrepiformibus.

A tree to 4 m tall, syncarps pendent on an elongated peduncle c. 30 cm long; syncarp c. 30 × 30 cm; phalanges c. 6 cm long, c. 3.5 cm broad, obovoid or claviform, the apex dome-like, the 5–6 carpels with



apices flush and nearly plane with the phalange-apex surface, the apical sutures shallow (1 mm or less in depth); stigmas terminal, c. 2 mm broad, oblique or plane, hippocrepiform; upper mesocarp cavernose, the chambers c. 10–14 mm high, pithy-fibrous; endocarp supramedian, osseous, reddish, nearly 15 mm long, nearly as broad as the phalange, rimose below, traversed especially laterally by mesocarp fibers; lower mesocarp c. 3–5 cm long, fibrous-fleshy; seeds c. 1 cm (?) long.

Holotype in the herbarium of the Arnold Arboretum, collected on Niue Island, Jan. 1940, by T. G. Yuncker (no. 10238). Isotype at BISH.

Distribution: The variety is known only from the type collection. However, it appears (from illustrations) to be somewhat similar to *Pandanus tectorius* var. *uapensis* F. Brown (1931), known so far only from Uapou, Marquesas. This variety is similar in that the phalanges are apically dome-like, with shallow apical sutures; but differs in the relatively larger endocarp positioned higher in the phalange.

Local name: *Fa niua*. According to Yuncker (1943), who assigned the specimen tentatively to *P. tectorius*, the natives of Niue distinguish two or more forms of *Pandanus*, one which they claim to be native to the island, called *fa vao*, and the other, said to be introduced, called *fa niua*. A third form is called *fa fi*. Should tradition be correct, this variety would presumably be native elsewhere. No specimens have been seen to match this, and only the Marquesan variety mentioned seems close among illustrated taxa. The word *fa* in Niue means *Pandanus*.

Nomina dubia

Pandanus tectorius var. *laevis* (Kunth) Warb. in Pflanzenr. 3 (IV. 9):

48. 1900; Yuncker in Bishop Mus. Bull. 178: 20. 1943.

A group of specimens are given this name, all of which are unarmed, the leaves lacking teeth; they are similar in having the caudate-flagellate apex characteristic of various species of Sect. *Pandanus*. Whether they represent a single cultivar derived from one species or not, is unknown.

Pandanus Veitchii Hort. ex Gard. Chron. 349. 1869; Yuncker l.c.

Again a cultivated plant, normally sterile, of the general relationship of littoral species of Sect. *Pandanus*. This, like the former, reported from Niue.

Pandanus verus Rumph. Herb. Amb. 4: 139. t. 74. 1743; Seem. Fl. Vit. 281. 1868.

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FIG. 2. *Pandanus compressus* Martelli, in the Shepherd Islands (Tongariki). Above: head of fruit. Below: habit of the trees showing the relatively broad leaves and pendent heads of fruit. (Photos courtesy of Jacques Barrau, formerly of the South Pacific Commission.)

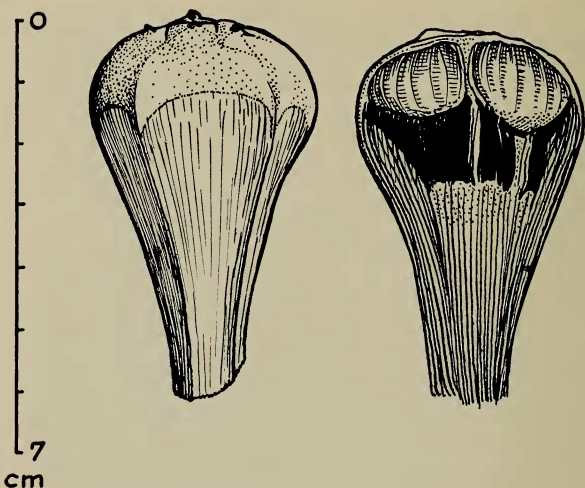


FIG. 3. *Pandanus tahitensis* var. *niueana* Stone. Representative phalange in full side view and in longitudinal section, natural size.

Seemann gives a rather long list of synonyms, some of which apply perhaps in interpretations later given; in any event, the Rumphian name is not tenable, and the plants Seemann had in mind are referable to *Pandanus upoluensis*, *P. tahitensis* and *P. polyacris*.

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